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Author: Adam Rostański, Stanisław Cabała, Jarosław Mielczarek

Citation style: Rostański Adam, Cabała Stanisław, Mielczarek Jarosław (2013). A new lowland locality of mountain plant *Streptopus amplexifolius* (L.) DC. (Silesian Voivodeship, Southern Poland). „Environmental & Socio-economic Studies” (2013, Vol. 1, iss. 2, s. 22-28), DOI: 10.1515/environ-2015-0009



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A new lowland locality for the mountain plant *Streptopus amplexifolius* (L.) DC. (Silesian voivodeship, Southern Poland)

Adam Rostański¹, Stanisław Cabała¹, Jarosław Mielczarek²

¹Department of Plant Systematics, Faculty of Biology and Environmental Protection, University of Silesia
Jagiellońska Str. 28, 41-200 Katowice, Poland

²Forest Inspectorate Koszęcin, Regional Direction Katowice, Sobieskiego Str. 1, 42-286 Koszęcin, Poland
E-mail address (corresponding author): adam.rostanski@us.edu.pl

ABSTRACT

The occurrence of mountain plant species in the Polish lowlands has been at the centre of attention of many botanists. In 2008–2011 we carried out field studies aimed at describing a new lowland population of White Twisted-stalk *S. amplexifolius* discovered in 2008. We focused on the following aims: to determine the current status of the lowland population of *S. amplexifolius*; to characterize phytocenoses and habitat conditions in which the species occur; to identify factors that can potentially pose a threat on the population and to propose guidelines for its protection. The newly discovered population is located in the Trójca Forest District (50° 38.737' N; 18° 48.945' E), forest department 61L. The main part of the population (ca. 70%) occupies an area of approximately 100 m². Currently, to protect the population from grazing, the whole area (about 0.25 ha) has been surrounded by metal mesh fence. The population occurs within a poorly developed patch of *Fraxino-Alnetum*. It contains 107 branched and fruiting individuals of *S. amplexifolius* and 83 smaller plants (branchless and sporadically fruiting). The number of fruits per plant varies between 6 and 20. One fruit contains an average of 5 seeds (a maximum of 12 seeds and a minimum of 3 seeds per fruit). The occurrence of numerous *Padus serotina* seedlings and young plants is recorded within the site. Human-related factors have caused substantial changes in the water relations and, subsequently, also in the species composition of these plant communities. The population of *S. amplexifolius* within the described site seems to be in good condition and develops normally.

KEY WORDS: *Streptopus amplexifolius*, population, chorology, reproduction, phytosociology

1. Introduction

The occurrence of mountain plant species in the Polish lowlands has been at the centre of attention of many botanists for many decades (SZAFFER, 1930; WALAS, 1938; CIACIURA, 1988; ZAJĄC, 1996). Many attempts have been made to explain what factors shape this pattern of occurrence, characterized by the presence of disjunctive populations north from continuous geographical distribution in the mountain areas of the Carpathians and the Sudetes. Even today there is no answer to the question of what shaped the disjunctive distribution observed in these taxa. Historical causes (relic localities), contemporary long-distance dispersal, as well as human activity are among possible factors responsible for this intriguing

pattern of geographical distribution. It seems that the fact that many mountain species show a tendency to occur in degraded, secondary, highly transformed plant communities (including ruderal ones) within disturbed habitats, may suggest contemporary expansion outside the main distribution range. Although the above described phenomena and the distribution ranges for many mountain species are relatively well documented (ZAJĄC, 1996; ZAJĄC & ZAJĄC, 2001), new localities are still being described, some old localities are disappearing and the conservation status for many of them is constantly changing.

We focused on the following aims: 1) To determine the current status of at the lowland population of *S. amplexifolius*; 2) To characterize phytocenoses and habitat conditions in which the

species occurs; 3) To identify factors that can potentially pose a threat on the population; 4) To propose guidelines for protection.

2. Geographical characteristics of the study area

The described locality of *S. amplexifolius* is located in Koszęcin (municipality Koszęcin) in Silesia (Southern Poland). The plant occurs here in the forest section 61L under the administration of the Trójca Forest District ("Uroczysko Bartosie")

(Regional Direction of Forestry - Katowice). Geographically, the area in question is part of the Silesian-Cracow Upland (KONDRACKI, 2009) and to the Silesian Upland if the geobotanical regionalization of Poland is considered (SZAFER, 1977) (Fig. 1).

Our observations showed that the largest cluster of *S. amplexifolius* is located about 4 metre from a ditch (a forest stream) in the part of the forest adjacent to the road, now enclosed by the fence. The terrain is slightly inclined towards the ditch.

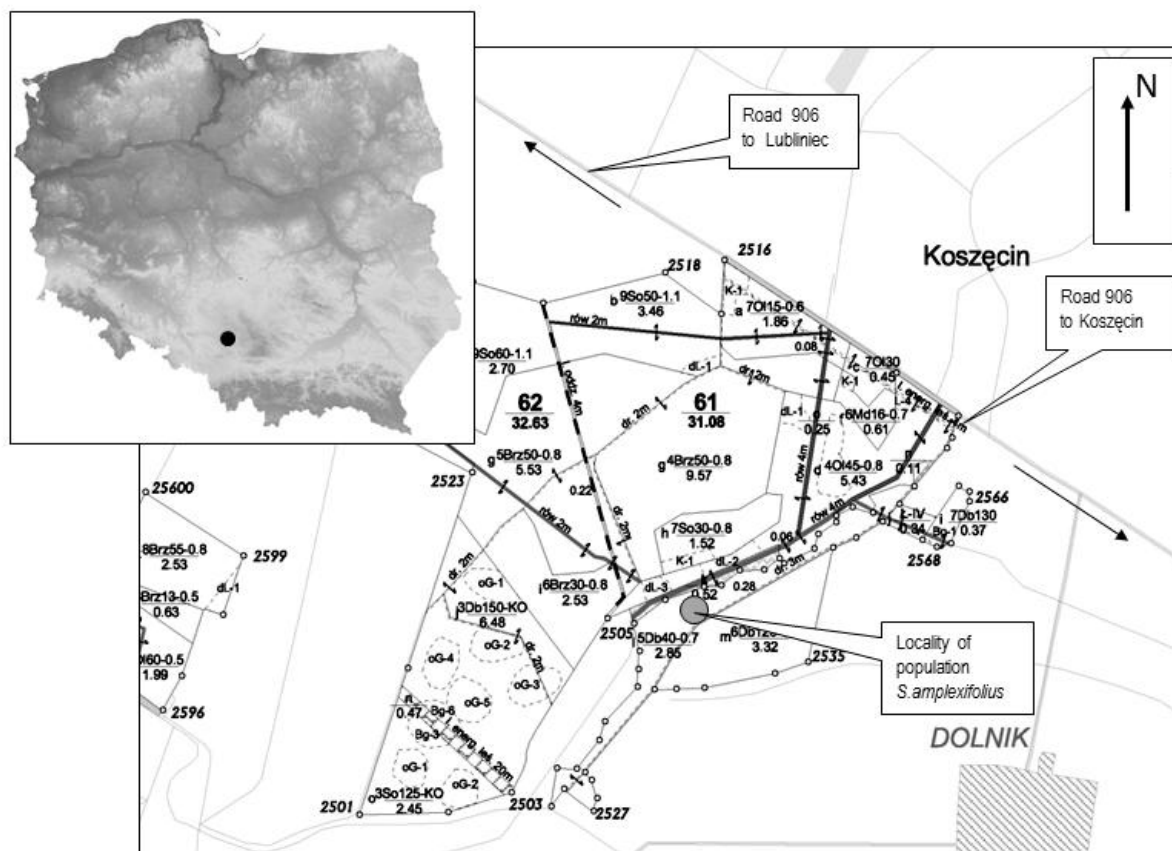


Fig. 1. Localization of the newly described population of *S. amplexifolius* near Koszęcin – (Silesian voivodeship, Southern Poland) against the background of forest sections delimitation

3. Methods

We characterized the plant community which includes the occurrence of *S. amplexifolius* as well as the phytocoenoses directly adjacent to it. The site was investigated for the first time in summer 2008. The population of *S. amplexifolius* consisted of over a dozen individuals. Many plants were heavily damaged and showed signs of grazing. Although the locality consisted of several patches with the occurrence of *S. amplexifolius*, the biggest patch was located near the forest road, within the forest department 61L, not far from a cultivated field.

Phytosociological relevés according to Braun-Blanquet method (BRAUN-BLANQUET, 1964) were

investigated in order to characterize plant communities within the area of the occurrence of *S. amplexifolius*. Basic population characteristics including the number of individuals, population density and structure (FALIŃSKA, 2002) were employed to characterize the current state of the investigated locality. Information on soil characteristic as well as their nomenclature within the investigated area have been presented according to data obtained from the Trójca Forest District administration (Forest inspectorate - Koszęcin). Taxonomic nomenclature followed MIREK ET AL. (2002), while the nomenclature of phytosociological units is according to MATUSZKIEWICZ (2008).

4. Results

4.1. Phytosociological characteristics of the new locality of *S. amplexifolius*

On the basis of phytosociological analysis taking into account floristic composition, species combination and overall assessment of habitat conditions we found that the community with the occurrence of *S. amplexifolius* can be classified as intermediate between plant associations from *Carpinion betuli* and *Alno-Ulmion*. The community showed symptoms of significant degeneration. The stand is young between 2nd and 3rd age class (30–40 years old), with canopy coverage about 70%. It consists mainly of *Populus tremula* (dominant species), with a much smaller share of *Alnus glutinosa*, and the occasional admixture of *Quercus robur*, *Padus avium* and *Betula pendula*. The understory coverage was estimated at 60%. The dominant species in the understory is *Padus serotina*. *Corylus avellana* is also a frequent species while *Viburnum opulus* and *Padus avium* occur only sporadically. The undergrowth is well developed and shows high species richness (more than 30 species) with overall coverage reaching 70%. *Oxalis acetosella*, *Streptopus amplexifolius*, *Padus serotina*, *Poa nemoralis*, *Anemone nemorosa* and *Rubus idaeus* are among the groundcover species with the highest frequency and coverage, while

other species have a relatively negligible share. The moss layer is poorly developed, its' coverage reaches only 5–10%.

We also investigated adjacent sites in this forest complex south west from the locality of *S. amplexifolius*. We found that the complex is dominated by poorly developed plant communities exhibiting a character intermediate between *Quercus robur*-*Pinetum* and *Tilio-Carpinetum*. Patches of the described community are floristically poor but its' structure is generally well developed. The stand is young, between 2nd and 3rd age class (30–40 years old), with canopy coverage about 60%. It is dominated by *Populus tremula* with *Betula pendula*, *Quercus robur* and *Padus serotina* as accompanying species. The shrub-layer has significant coverage, which reaches 80%. It is dominated by *Padus serotina*, with sporadic admixtures of *Corylus avellana* and *Euonymus europaea*. The groundcover is generally poorly developed, with the coverage reaching 60%. It lacks both characteristic and distinguishing species that would made possible classification of the phytocenosis to a specific association or even alliance. The groundcover is dominated by species with broad ecological niches: *Oxalis acetosella*, *Rubus idaeus*, *Poa nemoralis*. We did not record the moss layer. The described community changes into *Molinio-Pinetum* further south-west. We did not record the presence of *S. amplexifolius* in that community (Tab. 1).

Table 1. Phytosociological differentiation of the plant community with *Streptopus amplexifolius* from a newly described locality near Koszęcin – (Silesian voivodeship, Southern Poland) (authors)

Successive no of relevé		1	2	3	4
Date		23. 07 2009			
Locality		Koszęcin Uroczysko Bartosie			
Forest District		Koszęcin			
Forest section		61L	61L	61L	61L
Area of relevé [m ²]		200	200	200	200
Cover of tree layer [%]		70	60	80	80
Cover of shrub layer [%]		60	80	10	20
Cover of herb layer [%]		70	60	90	90
Cover of moss layer [%]		-	-	-	5
Number of species in relevé		25	18	22	32
<i>Fraxino-Alnetum</i> + <i>Alnenion glutinoso-incane</i>^o + Ch <i>Alno-Ulmion</i>:					
<i>o</i> <i>Alnus glutinosa</i>	a	1.1	.	5.5	5.5
	b	.	.	.	+
+ <i>Frangula alnus</i>	b	.	.	.	+
+ <i>Lysimachia vulgaris</i>		+	+	+	1.1
<i>o</i> <i>Oxalis acetosella</i>		3.3	4.4	1.3	+3
<i>o</i> <i>Athyrium filix-femina</i>		+	+	.	+
<i>Festuca gigantea</i>		+2	.	.	+2
<i>o</i> <i>Caltha palustris</i>		+2	.	.	.
<i>Circea lutetiana</i>		.	.	.	1.1
<i>Plagiomnium undulatum</i>	d	.	.	.	+

Ch.Querco-Fagetea:					
<i>Cerasus avium</i>	a	+	.	+	.
	b	+	.	2.1	+
	c	.	.	+	+
<i>Corylus avellana</i>	b	2.2	2.3	1.1	2.3
<i>Euonymus europaea</i>	b	+	.	.	.
<i>Anemone nemorosa</i>		1.1	.	+	+
<i>Aegopodium podagraria</i>		.	.	+	2.3
<i>Impatiens noli-tangere</i>		.	.	1.3	+
<i>Poa nemoralis</i>		2.2	1.3	.	.
<i>Brachypodium sylvaticum</i>		.	.	.	+3
<i>Fagus sylvatica</i>	c	.	.	+	.
<i>Scrophularia nodosa</i>		.	.	+	.
<i>Stachys sylvatica</i>		.	.	.	+
Accompanying species:					
<i>Padus serotina</i>	a	.		+	.
	b	3.3	5.5	.	1.1
	c	2.3	.	+	+
<i>Quercus robur</i>	a	+	+	.	+
	c	+	.	+	+
<i>Populus tremula</i>	a	4.4	4.4	.	+
	b	.	.	.	+
	c	+	.	.	.
<i>Betula pendula</i>	a	+	1.1	.	.
<i>Ribes spicatum</i>	b	.	.	+	+
<i>Viburnum opulus</i>	b	+	.	.	.
<i>Impatiens parviflora</i>		1.1	+	1.1	1.1
<i>Rubus idaeus</i>		1.3	2.3	+	+
<i>Humulus lupulus</i>		.	+	+	+
<i>Sorbus aucuparia</i>	c	r	+	+	.
<i>Dryopteris carthusiana</i>		.	+	+	.
<i>Geum urbanum</i>		.	.	+	+
<i>Phalaris arundinacea</i>		.	.	+	+
<i>Ranunculus repens</i>		.	.	+	2.3
<i>Streptopus amplexifolius</i>		2.3	.	.	+
<i>Vaccinium myrtillus</i>		+3	+3	.	.
<i>Carex brizoides</i>		.	.	4.4	.

Sporadic species: *Deschampsia caespitosa* 1; *D. flexuosa* 1; *Filipendula ulmaria* 4; *Juncus effusus* 4; *Majanthemum bifolium* 1; *Molinia caerulea* 2; *Peucedanum palustre* 2; *Rubus plicatus* 1; *Scirpus sylvaticus* 4; *Urtica dioica* 4; *Trientalis europaea* 2.

Fraxino-Alnetum phytocoenoses are located south-east from the locality of *S. amplexifolius*. The habitat is here typical for the community. It shows, however, water deficit, indicated by impoverished species composition. The stand is old, between the 4th and 5th age class (60–100 years old), with the canopy coverage 80%, and it is dominated by *Alnus glutinosa*. Sporadically *Padus avium* and *Padus serotina* can also be found. The understory is generally poorly developed, with the overall coverage reaching only 10%. The understory is dominated by *Padus avium* and *Corylus avellana* with sporadic occurrence of *Ribes spicatum*. The groundcover is well developed, although it shows lower species richness compared with typical communities of *Fraxino-Alnetum*. The groundcover is dominated by *Carex brizoides* (50% coverage) with *Impatiens noli-tangere*, *I. parviflora* and *Oxalis acetosella* as accompanying species. Other species occur

sporadically. According to information acquired from foresters, several individuals of *S. amplexifolius* were recorded here in the past years. We did not, however, confirmed the occurrence of the species here during our observations.

Well-developed community of *Fraxino-Alnetum* are located north and north-east from the locality of *S. amplexifolius*. These communities show the highest species diversity. We recorded presence of 30 plant species in one phytosociological relevé. The community is typically developed. The stand is moderately old, between the 3rd and 4th age class (40 – 80 years old), with the canopy coverage 80%, and it is dominated by *Alnus glutinosa* with a minor admixture of *Quercus robur*. The understory is well developed and rich in species. It has a coverage of 20%. It is dominated by *Corylus avellana*, with significant share of *Padus serotina*. *Padus avium*, *Alnus glutinosa*, *Frangula alnus*, *Populus tremula* and *Ribes rubrum* can also be found,

showing, however, lower coverage. The groundcover is particularly well developed and lush, with the overall coverage reaching 90%. Among the most frequent species *Aegopodium podagraria*, *Ranunculus repens*, *Rubus idaeus*, *Circea lutetiana* and *Lysimachia vulgaris* can be enumerated. Species characteristic of *Quercus-Fagetea* communities are also very abundant. In the described phytocoenosis numerous species characteristic for *Fraxino-Alnetum* communities can be found as well. We also recorded the presence of *S. amplexifolius* here (one intact, branched individual and several others showing traces of grazing). The moss layer is poorly developed, with the total coverage of about 5%, and is formed by *Plagiomnium undulatum*.

4.2. The current state of the *S. amplexifolius* population

During our observations of the population of *S. amplexifolius* we recorded the presence of 190

branched, well developed and fruiting plants and 107 branchless individuals (some of them fruiting). All the recorded plants showed no signs of disease or poor physiological condition. On the basis of ten measurements performed on randomly chosen plants we established that each plant produced from 6 to 20 fruits, and 3 to 12 seeds in each fruit (Tab. 2). We noticed that plants producing numerous fruits, showed low seed production per fruit. On the basis of our preliminary observations in 2008 we established that the large population of highly competitive and invasive *P. serotina* can be perceived as a potential threat to *S. amplexifolius* due to its shading effect. In 2009 larger plants of *P. serotina* were removed, but it still occurs in the groundcover in the form of seedlings and young plants. This is confirmed by the fact that *S. amplexifolius* scarcely occurs in the forest communities around the main site (that has been fenced) and that all the plants growing outside the main site are heavily damaged by grazing (Figs. 2 and 3).

Table 2. The generative organs structure (sexual reproduction characteristics) of individuals within the newly described population of *S. amplexifolius* (authors)

Number of individual	1	2	3	4	5	6	7	8	9	10
No of fruits / individual	14	12	11	7	17	16	20	16	6	12
No of seeds / fruit	12	12	5	5	3	3	5	5	11	10



Fig. 2. The current (Summer 2011) view of the *S. amplexifolius* population near Koszęcin, Silesian voivodeship (authors)



Fig. 3. View of an *S. amplexifolius* individual from the population near Koszęcin, Silesian voivodeship (authors)

5. Discussion

The population of *S. amplexifolius* newly described by us is the second largest lowland population in the Silesian voivodeship after the well known, studied and monitored population of the species in “Ochojec” nature reserve in Katowice (PARUSEL, 1984, 1986, 1995, 2011).

Habitat conditions here are very similar to those in “Ochojec” nature reserve. It is one of the over a dozen lowland localities of the species (HEREŹNIAK, 1982; ZAJĄC, 1996). The population seems to be in good condition.

S. amplexifolius has been previously recorded mainly from forest communities, with one exception, when the occurrence of the species was confirmed

in a wet meadow community in Wachowice. There are some doubts whether the newly described site can be classified as a “relic locality”, mainly because its habitat, which is far from being natural. The current state of the plant community where *S. amplexifolius* occurs, as well as the state of adjacent plant communities, suggest the long-standing impact of human activity. This would probably make impossible survival of the species within the same area since the late glacial, as human impact within the investigated area has caused severe changes in both habitat conditions and plant cover. Human related factors have caused substantial changes in water relations and, subsequently, also in species composition of plant communities. A recent, long-distance dispersal event is more plausible explanation for the emergence of the newly described population of *S. amplexifolius*. Further studies, especially genetic analyses, are needed to elucidate this problem. It seems that grazing is now the most important factor that could influence the stability and proper functioning of the population. This patch, covering an area of about 200 m², has been surrounded by metal mesh fence of a height of about 2 m. In 2008 the species occurred within a plant community dominated by *Padus serotina*. This posed a potential threat to the population of *S. amplexifolius*, as *P. serotina* is highly competitive. After the construction of the fence (2009), significant number of *P. serotina* shrubs were removed as well as some of the trees. This treatment improved light conditions on the forest floor and had a positive effect on the population of *S. amplexifolius*. This was confirmed by our further observations in 2009-2011.

A similar threat to *S. amplexifolius* is present also in the “Ochojec” nature reserve in Katowice (PARUSEL, 1995, 2011). The only effective treatment so far applied to reduce the negative effect of grazing on *S. amplexifolius* populations, is fencing the largest possible area with the occurrence of the species. This strategy seems to protect plants quite efficiently, allows sexual reproduction and thus facilitates not only preservation but also propagation of this rare species.

6. Conclusions

On the basis of the field study and observations carried out in 2008, 2009 and 2011 we found that:

(1) The newly described lowland population of White Twisted-stalk *S. amplexifolius* population is large and in good condition.

(2) Phytosociological analysis showed that the current state of the plant community and the local habitat show clear traces of long-standing and severe impact of human activities.

(3) For this reason, it is unlikely that this population is late glacial relic or that it emerged shortly after in early Holocene. In order to elucidate the problem of the origin of this population, genetic analyses should be undertaken.

(4) Grazing is the most important threat for the newly described population. The impact of grazing can be effectively limited by fencing the area. This in turn promotes sexual reproduction and allows the plant to colonize adjacent areas with identical or similar habitat conditions.

(5) We did not record any evident effects of the abundant occurrence of *P. serotina* seedlings and young plants on the newly described population. No negative changes were recorded suggesting deterioration of habitat conditions caused by *P. serotina*.

(6) It seems likely that the preservation of the existing condition of habitat and plant cover will ensure that further development of the newly described population development is not threatened.

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